EFFECT OF A DIRECT INSTRUCTION FLASHCARD SYSTEM FOR INCREASING THE PERFORMANCE OF BASIC DIVISION FACTS FOR A MIDDLE SCHOOL STUDENT WITH ADD/OHI

By

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ABSTRACT

The purpose of this study was to evaluate the effects of a Direct Instruction (DI) flashcard system on the mastery, accuracy and fluency of basic division math facts (numbers 0-12) for a seventh grade boy, diagnosed with Attention Deficit Disorder (ADD). The effects of the DI flashcard system were examined in a multiple baseline design across problem sets. DI flashcards require the student to provide the correct solution quickly and if an error occurs, the student is required to engage in error correction using a model, lead, and test procedure. The overall outcomes indicated large increases in student accuracy. Maintenance of treatment gains was also found with several division facts with our participant. The present outcomes replicate the range of classroom settings and disability designations. For the most part, employing flashcard procedures were easy to implement and evaluate in a middle school resource classroom setting.

Keywords: Math Facts, ADD, DI Flash cards, Model, Lead, Error Correction, Long Division, Middle School Student.

INTRODUCTION

Students who have difficulties in mathematics tend to use time-consuming, inefficient, and error prone strategies to solve simple calculations. These include such strategies as counting on their fingers, rather than recounting answers from memory (Byers, 2009). Having difficulty in math has been linked to dropping our difficulty by finding and keeping a job (Murnane, 2007), and wages earned (Murnane, Willett, Duhaldeborde, & Tyler, 2000; Murnane, Willett, & Levy, 1995).

Attention Deficit Hyperactivity Disorder (ADHD/ADD) is a neurobehavioral disorder of childhood, characterized by severe, developmentally inappropriate motor hyperactivity, inattention, and impulsiveness which results in impairment in more than one setting (Barkley, 2006; Verma, Balhara, & Mathur, 2011). Within the past decade, there has been a rapid increase in the diagnosed cases of Attention Deficit Disorder (ADD) and Attention Deficit Hyperactivity Disorder (ADHD). Many teachers have complained about those increases and what it has done to their classrooms (Purdie, Hattie, & Carroll, 2002). In an educational context, the symptoms of ADD and ADHD are most often based upon the idea that for a child to function properly in a classroom where those symptoms should not be occurring (Purdie et al., 2002). When a student has difficulty of functioning properly in the classroom, it is easier for them to fall behind in school and quickly lose interest, partly because of the failure to engage and motivate students effectively (Martin & Pickett, 2013). This can be an issue for the students who are diagnosed with ADD and ADHD, as it is much harder to motivate and keep them focused (Barkley, 2006). When students fall behind, it is an arduous task to catch them up, especially when students begin to fall behind their grade level standards. When students fail to learn and master basic skills, it becomes challenging to teach successive skills or strategies which are build upon and use those as simpler and more basic skills. Specifically, when students struggle with the mastery of basic math facts, it becomes more difficult to teach them the successive strategies building upon the use of basic facts (Al-Makahleh, 2011).

An easy to implement and manage flash card system to

teach basic skills has been the Direct Instruction (DI) flash card system. This strategy has been widely used to teach students quickly and effectively to mastery (Silbert, Carnine, & Stein, 1981; Skarr, Ruwe, Zielinski, Sharp, Williams, & McLaughlin, 2014). When using this system, each set of flash cards are being taught to be presented in a carefully planned sequence, introduced systematically to facilitate learning while avoiding confusion (Stein, Kinder, Silbert, & Carnine, 2006). Students are required to engage in model, lead, and test error correction as they are presented their flashcards and make an error. Errors receive additional practice by placing error flashcards two or three back from the top of the stack. Error cards are placed close to the top of the stack until the student can correctly say the problem and its solution of three consecutive presentations in a row (Silbert et al., 1981). The use of a DI flashcard system benefits most of the students, quickly and effectively teaching them to mastery, accurately and fluently. DI flashcards teach retention of previously mastered facts through less frequent practice after mastery.

The DI flashcard system has been successfully implemented in a wide range of special and general education classroom settings. These have ranged from self-contained classrooms at the preschool, elementary, middle, and high level (Brasch, Williams, & McLaughlin, 2007; Cole, McLaughlin, Neyman, & Johnson, 2013; Delong, McLaughlin, Neyman, & Wolf, 2013; Fjortoft, McLaughlin, Derby, Everson, & Johnson, 2014; Hayter, Scott, McLaughlin, & Weber, 2007; Pierce, McLaughlin, Neyman, & King, 2012; Ruwe, McLaughlin, Derby, & Johnson, 2011), in resource rooms at the elementary school level (Erbey, McLaughlin, Derby, & Everson, 2011; Kaufman, McLaughlin, Derby, & Waco, 2011; Lund, McLaughlin, Derby, & Everson, 2012; Mann, McLaughlin, Williams, Derby, & Everson, M. 2012; Pfaff, McLaughlin, Neyman, & Everson, 2013), and in general education settings as well as public school classrooms (Skarr et al., 2014; Walker, McLaughlin, & Weber, 2012). DI flashcard systems have even been successfully implemented in home (Aldahri, Weber, & McLaughlin, 2013; Mann et al., 2012). DI flashcards have been effective in teaching a wide range of skills including sight word vocabulary (Kaufman et al., 2011), math facts (Brasch et al., 2007; Erbey et al., 2011; Lund et al., 2012; Pierce et al., 2012; Walker et al., 2012), and spelling (Skarr et al., 2012).

Objectives

The purpose of this study was to evaluate the effects of a DI flashcard system on the mastery, accuracy and fluency of basic division math facts (numbers 0-12) of seventh grade boy, diagnosed with ADD. DI flashcards have been effectively employed on elementary students with ADHD, and an additional purpose was to attempt and replicate our prior outcomes (Pfaff et al., 2013) with a middle school student with ADD. Finally, most of the previous work with DI flashcards has involved teaching addition, subtraction, or multiplication facts. This case report will be the first time what authors have attempted to teach long division with DI flashcards.

Methodology

Participant and Setting

The participant Jake was a 13-year-old boy enrolled in seventh grade at a local, urban middle school. Our participant had an IEP (Individual Education Plan) for several years in the school district. However, the participant was included in some general education classes. He had been diagnosed with Attention Deficit Disorder as well as with an Other Health Impairment (OHI). Those two labels were employed to qualify him for special education services. He was not taking any medication at the time of data collection. He did not engage in inappropriate behaviors during the school and have discipline concerns. Jake was the middle child in a family of five brothers and four sisters, with a very supportive mother. One of the participant's special education teachers recommended him to take part in the research project due to his difficulty in his math class, emanating from his difficulty with basic division facts.

The study took place in a classroom setting at a large, urban, public middle school in the Pacific Northwest. It occurred during a sixth period math class on Tuesday and Thursday afternoons. Sessions lasted for approximately one hour at a table separated from the rest of the class.

Because, the study occurred during the time of sixth period when it was often noisy with distractions coming from the 27 other students in the classroom at that time. This study was conducted over seven weeks by the first two authors after completing a course as part of their academic training in special education at a local private University (McLaughlin, B. Williams, R. Williams, Peck, Derby, Bjordahl, & Weber, 1999).

Materials or Tools Used

A set of 91 flashcards including the basic division facts (0-12) was provided by the classroom teacher. Those flashcards were used for baseline and all our intervention procedures. Data collection sheets were also developed and employed for both baseline and intervention. The first data sheet was numbered each session and for each session, only the incorrect responses were recorded by listing the fact in its respective column, which were organized by the number being divided. This data sheet simply organized and listed the incorrect responses for the first five presentations of all 91 flashcards. This allowed the first two authors to eventually separate the unmastered facts into sets. The other data collection sheet listed each to separate the set of unknown facts, with areas to record the number of corrects and errors during baseline and intervention. It also contained spaces to keep track of how many correct responses occurred in maintenance stage for each set.

Dependent Variable and Measurement

The target behavior in this study was mastery of basic division facts. The participant's response was defined as correct if the participant was able to respond with the correct answer for the fact shown within two seconds of the presentation of the flashcard. A response was considered incorrect if the student did not respond with the correct answer, if the participant verbally stated that he was unsure of the answer, or if it took him longer than two seconds to respond. Four sets of division facts were created and contained five unmastered facts of each set. The first two authors also placed the five mastered facts in each set. Data were only gathered for the unmastered problems in baseline, DI flashcards, and maintenance.

Experimental Design and Conditions.

A non-concurrent multiple baseline and ABA (Applied Behavior Analysis) single case design (Kazdin, 2011; McLaughlin, 1983) across four sets of math facts. This was employed to examine the efficacy of DI flashcards and if the student could maintain his performance over time. A description of the various conditions are as follows.

Baseline

During baseline, Jake was required to provide a response to the division flashcards that were presented to him. The flashcards were a full set of 91 basic division facts. The researcher presenting the cards would allow the student enough time to respond (about 2-3 seconds), and place the cards in corresponding piles depending on whether or not the participant responded correctly. When the student struggled with certain facts, the first two authors would assure him that, it was acceptable to not know an answer. This was done to motivate our participant to keep trying with the remainder of the deck of flashcards. This baseline procedure allowed the first two authors to determine which were the cards that the student did not know. After separating the facts, Jake answered incorrectly three or more times, which cards were separated into sets of five. Baseline was then collected with each set of five unmastered facts. Baseline was in effect for five sessions for all four sets.

DI flashcard system

A DI flashcard system was implemented to assist the student in mastery of basic division facts. The five unmastered flashcards for each set were mixed in with 20 mastered flashcards to create a drill deck. Beginning with the first deck, one researcher would begin the daily drilling procedure in which the researcher presented a flashcard to the student, who would respond with either a correct or incorrect response. If Jake responded with a correct answer, the flashcard was placed at the back of the deck and the researcher proceeded by showing him the next card. If incorrect (meaning he responded with an incorrect answer, took longer than two seconds, or said that he did not know), the researcher would implement a

model, lead, test procedure and place the flashcard back one card in the deck. In the occurrence of a correct answer at the second presentation, the particular card was placed back two or three cards from the front of the deck, moving back in the deck one or more cards with each correct response. After the fact had been answered correctly three times, the card would be placed in the back of the drill deck.

Once a set had been mastered, the first two authors would move on to the daily testing procedure for that set. During daily testing, one author presented the flashcards to Jake. If he responded correctly, a plus sign was marked on the corresponding space on the data sheet. If he responded incorrectly, a minus sign was recorded. When a division fact was marked correct for three sessions, it was considered mastered. After each card in the set had been mastered, the first two authors proceeded to next set. This procedure occurred for each set. The number of sessions for DI flashcards ranged from 4 to 6 sessions and took place at different points in time with the various sets. This allowed for the effects of DI flashcards to be evaluated in a modified multiple baseline design.

Maintenance

For maintenance, the first two authors assessed the participant using only the mastered cards from previously taught sets. For example, maintenance for Set 1 only employed the division facts that were unknown and employed in Set 1. If an incorrect response occurred during maintenance, one of the first two authors would implement the model, lead, test error correction procedure (Marchand-Martella, Slocum, & Martella, 2004). This was the same as employed during DI flashcards. The number of sessions in maintenance ranged from 0 to 14 sessions. Maintenance for Set 4 never occurred.

Reliability of Measurement

Interobserver agreement was conducted during every session. Throughout the study, one of the first two authors presented the flashcards to Jake, making two separate piles of cards, one for correct responses and another for incorrect answers. The other researcher observed Jake and recorded on the data sheet whether his response was correct or incorrect. The correct and incorrect answers were compared after testing each set. The procedure for interobserver agreement throughout intervention and maintenance procedures were identical. The calculation for interobserver agreement was the number of agreements over agreements plus disagreements times 100. The average interobserver agreement throughout the study was 100%.

Results

The number of basic division facts answered correctly for each set during baseline, intervention, and maintenance

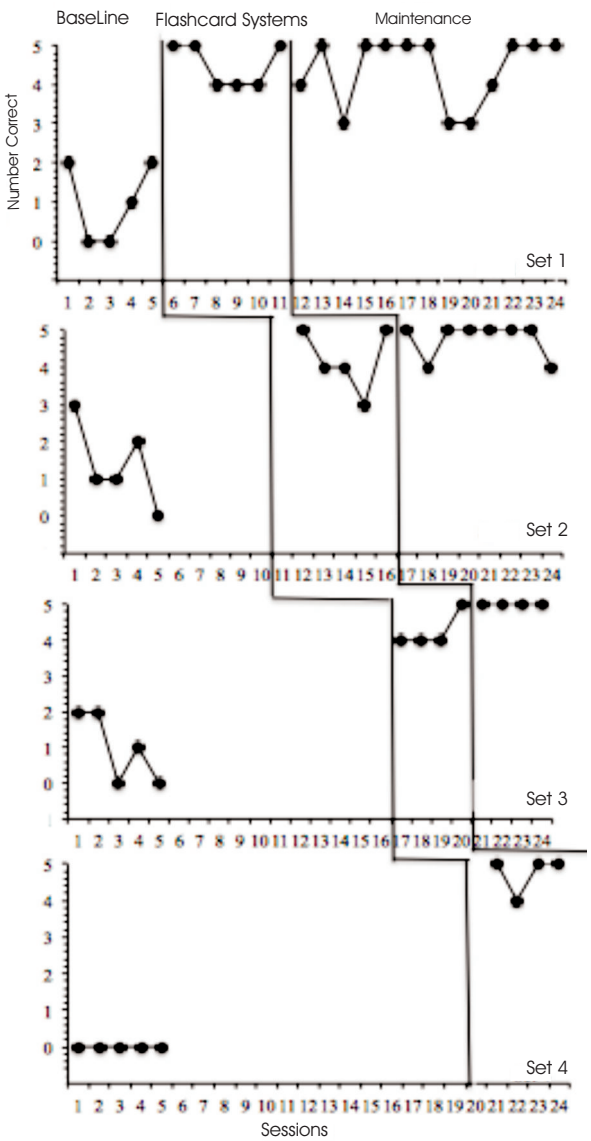

Figure 1. Number of correct responses for the four sets of division facts during baseline and DI flashcards

are displayed in Figure 1. During baseline, across all four sets of unmastered facts, the number of correct responses ranged from 0 to 3 out of five possible (0-60%). During the DI flashcard system, the number of correct responses increased. For Set 1, the number of corrects ranged from 3 to 5 or from 60 to 100%. Maintenance resulted in correct responses ranging from 3 to 5 facts or 60 to 100% accuracy per set. For baseline, Set 1 averaged 20% accuracy. This increased to an average of 90% during intervention and 88% throughout maintenance. Set 2 baseline averaged 28%. It increased to a mean of 84% during DI flashcards. Set 2 performance averaged 90% during maintenance. Set 3 averaged 20% in baseline. It increased to 85% for DI flashcards. During maintenance with Set 3, perfect performance was found (M = 100%). The baseline for Set was low and averaged 0%. When DI flashcards were employed, student performance increased (M = 95% correct).

Recommendations

The use of a DI flashcard system to improve the academic performance for a seventh grade boy diagnosed with Attention Deficit Disorder on basic division facts was effective. During DI flashcards, the participant improved the accuracy of his unmastered division facts. The use of the model, lead, test procedure during the daily practice for each set was definitely the most useful and beneficial aspect of the DI flashcard procedure.

The use of DI flashcard procedures was very practical, time efficient, and not difficult to implement in the resource room. Within the hour spent with the student, for twice a week, the first two authors were easily able to complete one full set (baseline, presenting flashcards, and testing) by each day. This also included the time to assess for maintenance of previously mastered facts.

Limitations

There were limitations in the present research. The first two authors began with a full set of 91 basic division facts, resulting in nine sets of five unmastered cards that were created, which was a very difficult goal for our participant. Because of time conflicts, only four sets were used. Although the first two authors met the student for approximately two hours each week, there were multiple instances where the participant was absent or was unable to participate in the study for a particular day at his teacher's request. The first two authors were unable to collect the amount of data they had hoped. The lack of taking baseline data when the intervention was taking place in three sets remains an issue (Kazdin, 2011; McLaughlin, 1983). Taking data on intermittent sessions in baseline with those sets would have been a manner in which to begin to solve this limitation. Also, the intermittent schedule to carry out the procedures occurred only on Tuesdays and Thursdays, to provide significant wait time between sessions for the participant. Specifically, from Thursday to Tuesday, it was not uncommon for the participant to perform poorly when reviewing sets had been mastered during the previous week. This caused the first two authors to spend more time to re-teach the participant's errors and this took time away from the data collection.

Another obstacle surrounding the study that could have impacted the amount of data collected was the setting in which the study took place. Because the study was conducted in the classroom while instruction was occurring, it was not uncommon for our participant to become bit unfocused on the task being presented. In addition, such things as noise and other classmates talking to him added to his distractions from the tasks at hand. This often caused the participant to either engage in conversations with his classmates or begin observing what was going on in rest of the classroom. Of interest, this did not seem to impact his ability to learn his math facts, but it only increased the time for the first two authors who were unable to collect the amount of data they wished.

Conclusions

Despite those obstacles impacting the amount of data collected, the use of a DI flashcard system was effective in teaching our four sets of basic division facts to mastery. During DI flashcard intervention, our data shows that the rate of incorrect responses to the presented fact decreased, while the number of correct responses increased. Also, the participant was able to master each

fact in the four sets that time allowed the first two authors to complete.

The present research replicated the efficacy of DI flashcards. These results provide additional evidence as to the effectiveness of employing the DI flashcard procedures. The present research adds the use of division facts with DI flashcards. Also, as we have found, DI flashcards can be employed in a middle school with older students with disabilities (Cole et al., 2013; Ruwe et al., 2011). Also, the present research employed a resource room setting that was similar to what the settings were in the previous research (Altharwa, Neyman, McLaughlin, & Johnson, 2014; Erbey et al., 2011; Mann et al., 2013; Pfaff et al., 2013) with DI flashcards. Maintenance of treatment gains was also documented (Stokes & Baer, 1977, 2003). This has also been demonstrated in much of our prior work with DI flashcards (Pierce et al., 2013; Skarr et al., 2012, 2014). With the small number of participants as well as the novel use of division facts, additional work with DI flashcards needs to take place.

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